

Geometry 11.3 Notes

Fundamental Theorem of Similarity (pp 677–678)

Fundamental Theorem of Similarity: If the ratio of the of the corresponding sides of two similar polygons is $\frac{a}{b}$, the ratios of the following are true:

Perimeters: $\frac{a}{b}$

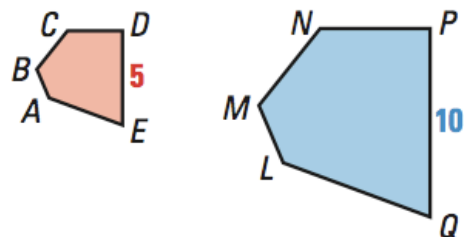
Areas: $\frac{a^2}{b^2}$

Volume: $\frac{a^3}{b^3}$

EXAMPLE 1 Finding Ratios of Similar Polygons

Pentagons $ABCDE$ and $LMNPQ$ are similar.

- Find the ratio (red to blue) of the perimeters of the pentagons.
- Find the ratio (red to blue) of the areas of the pentagons.



SOLUTION

The ratio of the lengths of corresponding sides in the pentagons is $\frac{5}{10} = \frac{1}{2}$, or 1:2.

- The ratio of the perimeters is also 1:2. So, the perimeter of pentagon $ABCDE$ is half the perimeter of pentagon $LMNPQ$.
- Using Theorem 11.5, the ratio of the areas is $1^2:2^2$, or 1:4. So, the area of pentagon $ABCDE$ is one fourth the area of pentagon $LMNPQ$.

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EXAMPLE 2 *Using Areas of Similar Figures*



COMPARING COSTS You are buying photographic paper to print a photo in different sizes. An 8 inch by 10 inch sheet of the paper costs \$.42. What is a reasonable cost for a 16 inch by 20 inch sheet?

SOLUTION

Because the ratio of the lengths of the sides of the two rectangular pieces of paper is $1:2$, the ratio of the areas of the pieces of paper is $1^2:2^2$, or $1:4$. Because the cost of the paper should be a function of its area, the larger piece of paper should cost about four times as much, or \$1.68.



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EXAMPLE 3 Finding Perimeters and Areas of Similar Polygons

OCTAGONAL FLOORS A trading pit at the Chicago Board of Trade is in the shape of a series of regular octagons. One octagon has a side length of about 14.25 feet and an area of about 980.4 square feet. Find the area of a smaller octagon that has a perimeter of about 76 feet.

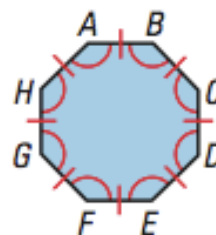
SOLUTION

All regular octagons are similar because all corresponding angles are congruent and the corresponding side lengths are proportional.

Draw and label a sketch.

Find the ratio of the side lengths of the two octagons, which is the same as the ratio of their perimeters.

$$\frac{\text{perimeter of } ABCDEFGH}{\text{perimeter of } JKLMNPQR} = \frac{a}{b} \approx \frac{76}{8(14.25)} = \frac{76}{114} = \frac{2}{3}$$



Calculate the area of the smaller octagon. Let A represent the area of the smaller octagon. The ratio of the areas of the smaller octagon to the larger is $a^2:b^2 = 2^2:3^2$, or 4:9.

$$\frac{A}{980.4} = \frac{4}{9}$$

Write proportion.

$$9A = 980.4 \cdot 4$$

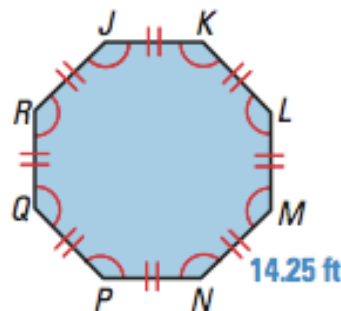
Cross product property

$$A = \frac{3921.6}{9}$$

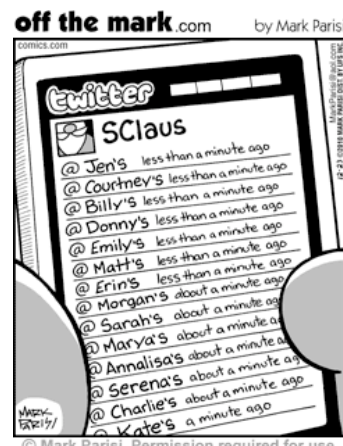
Divide each side by 9.

$$A \approx 435.7$$

Use a calculator.



► The area of the smaller octagon is about 435.7 square feet.



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Guided Practice.

5. Two similar polygons have perimeters 7 cm and 28 cm respectively. Find the area of the smaller figure if the area of the larger is 48 cm^2 .

6. How can you find the area of a polygon if you know its perimeter and the perimeter and area of a similar polygon?

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